I. PATENT ABSTRACTS OF JAPAN

(11)Publication number : **07-034883**
(43)Date of publication of application : **03.02.1995**

(51)Int.Cl. **F02B 29/08**
F01L 1/34
F01L 1/44
F02D 13/02

(21)Application number : **05-189176**
(22)Date of filing : **30.06.1993**

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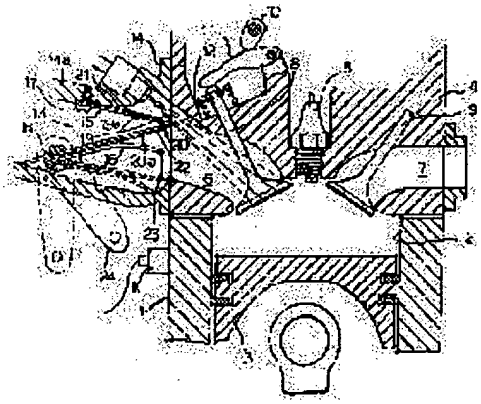
(54) **MILLER CYCLE ENGINE**



(57)Abstract:
PURPOSE: To prevent reduction of a maximum output in a miller cycle engine in which a closing timing of an intake valve presents before the bottom dead center by providing a check valve which opens a valve body in an intake system when a phase of an intake cam shaft is varied under a full load condition.
CONSTITUTION: In a miller cycle engine, a valve timing of an intake valve 10 is varied by means of an opening/closing timing adjusting mechanism, and an intake valve 8 is closed at a specified timing in a bottom dead center under a condition of a partial load or a knocking control. Large overlapping is generated between the intake valve 8 and an exhaust valve 9. The exhaust valve 9 and the intake valve 8 are opened simultaneously in an exhaust process, so that pushing into an intake port 6 is apt to occur. Contraflow of exhaust gas is prevented by arranging a check valve 13 in an intake pipe 14. Under the full load condition, resistance for flow in the intake passage is reduced to substantially the same extent as an ordinary engine by fully opening the check valve 13, to secure the output substantially the same as before.

CLAIMS

[Claim(s)]
[Claim 1] The Miller cycle engine characterized by arranging the check valve which opens a valve element when changing the phase of said air inlet cam shaft to an induction system in a full load condition while constituting said inlet valve of the engine equipped with ** and an exhaust valve so that a phase might be driven to a crankshaft with the air inlet cam shaft which may change.
[Claim 2] The Miller cycle engine according to claim 1 characterized by the phase of the air inlet cam shaft over a crankshaft changing gradually.
[Claim 3] The Miller cycle engine according to claim 1 characterized by the phase of the air inlet cam shaft over a crankshaft changing to a stepless story.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to a Miller cycle engine and the Miller cycle engine which makes inhalation-of-air resistance small especially, and can maintain the maximum output.
[0002]
[Description of the Prior Art] The so-called Miller cycle engine brings forward an inhalation-of-air valve-closing time term from a bottom dead point, to this, therefore, tends to make zero substantially the negative workload (the so-called pumping loss) generated according to the inhalation-of-air diaphragm by the throttle valve in the time of a partial load, and tends to suppress decline in cycle efficiency. Moreover, in order to set an expansion ratio or more to 11 and to make a compression ratio about [within a knocking limitation] into ten, an inhalation-of-air valve-closing time term is brought forward from a bottom dead point. Moreover, when it supercharges, an expansion ratio is set or more to 11, and it is going to maintain high thermal efficiency, reducing a substantial compression ratio and controlling knocking by bringing forward an inhalation-of-air valve-closing time term according to knocking. In order to realize the above-mentioned Miller cycle engine, this invention person thought out using together the rotary bulb which can change the closed stage of an inhalation-of-air path into the usual inlet valve with a fixed closing motion stage, as shown in JP,58-55329,B.
[0003] However, the present condition is inhalation-of-air resistance increasing by installing in an inhalation-of-air path, in order to use the above-mentioned rotary bulb together with an engine inlet valve, and especially for this reason, fully being unable to

attain the purpose of the pumping loss reduction at the time of a partial load, but a rotary bulb's raising inhalation-of-air resistance in non-supercharged petroleum engine, at the time of a full load, and making the maximum output decrease.

[0004]

[Problem(s) to be Solved by the Invention] This invention is thought out in view of the above, and the place made into the purpose makes a pumping loss zero substantially at the time of a partial load, lowers the inhalation-of-air resistance at the time of a full load even to a usual engine and this level, and is to offer the Miller cycle engine which can demonstrate this output.

[0005]

[Means for Solving the Problem] When changing the phase of said air inlet cam shaft to an induction system in a full load condition, this invention Miller cycle engine for attaining said purpose is characterized by arranging the check valve which opens a valve element, while it constitutes said inlet valve of the engine equipped with ** and an exhaust valve so that a phase may be driven to a crankshaft with the air inlet cam shaft which may change.

[0006]

[work --] for In this invention Miller cycle engine which becomes the above-mentioned configuration Although exhaust gas tends to flow backwards to an inhalation-of-air path in order that an inlet valve may open to coincidence mostly with an exhaust valve when the time of a partial load or knocking tends to be changed at the time of control so that the closing motion stage of said inlet valve may be brought forward for the phase of said air inlet cam shaft, an inlet valve tends to be closed at an early stage and it is going to realize a mirror cycle The valve element of said check valve arranged in the induction system closes, and the back flow of the exhaust gas to an inhalation-of-air path is prevented. Therefore, by inhaling into a cylinder the exhaust gas which flows backwards to an inhalation-of-air path like the following inhalation-of-air line, oxygen runs short and imperfection or the fault which becomes impossible is beforehand removed for combustion. moreover, by opening the valve element of said check valve at the time of a full load, this invention Miller cycle engine can usually carry out the until [comparable] fall of the resistance of the flow of an inhalation-of-air path mostly with an engine, and can also secure an output almost to the same extent.

[0007]

[Example] In drawing 1 , 1 is this invention Miller cycle engine, and the piston to which 2 slides on a cylinder and 3 slides on the inside of this cylinder 2, and 4 are the cylinder heads. On both sides of the ignition plug 5 prepared on the center line of a cylinder 2, a suction port 6 and the exhaust air port 7 are formed in this cylinder head 4, and the inlet valve 8 and exhaust valve 9 which open and close the cylinder 2 side opening of both the ports 6 and 7 respectively are arranged. Said inlet valve 8 is opened and closed through the rocking lever 11 with the air inlet cam shaft 10 which rotates synchronizing

with the crankshaft which is not illustrated and can change the phase. In addition, 12 is a valve spring. Moreover, said exhaust valve 9 is opened and closed by the exhaust cam shaft and lever (neither is illustrated) which are rotated synchronizing with the crankshaft which is not illustrated.

[0008] 13 is a check valve and is arranged in the inlet pipe 14 attached in the cylinder head 4 according to said suction port 6. The check valve 13 consists of valve elements 15 and 16 of a pair, and another side 16 is supported by this tube wall 14a with the shaft 18 in the end, and while 15 ****s an end and fixes it to inhalation-of-air tube wall 14a by 17 on the other hand, each other end side of the above-mentioned valve elements 15 and 16 is formed so that it may stick when [that] it contacts mutually, and an inlet pipe 14 may be closed. Moreover, said valve elements 15 and 16 consist of a guide 23 prepared in the outside of the ports plates 19 and 20 which opened Through-holes 19a and 20a respectively, the reed valves 21 and 22 made from beryllium copper, and a reed valve 22, and a valve element 16 can be opened until it sticks to an inhalation-of-air tube wall 14a inside by the rotation lever 24 attached in said shaft 18.

[0009] As equipment which changes the phase of the air inlet cam shaft 10 which drives said inlet valve 8, the closing motion stage adjustment device 25 shown, for example in drawing 4 and drawing 5 can be used. Namely, while this closing motion stage adjustment device 25 engraves the helical spline 27 twisted to the one direction on the edge of said air inlet cam shaft 10 by which bearing was carried out to bearing 26 On the air inlet cam shaft 10 and the same axle, said helical spline 27 and the helical spline 28 twisted to hard flow are engraved at the edge. ******** 29 by which bearing was carried out is formed in bearing 26'. Between the above-mentioned spline 27 and 28 The adjustment piece 32 which has gear teeth 30 and 31 in a both-ends inside is set among both shafts so that each gear teeth 30 and 31 may gear with each helical splines 27 and 28. Said adjustment piece 32 is made to move through a lever 33 with the actuator (not shown) which operates with an accelerator pedal (not shown), a knock sensor K, or a predetermined intake pressure, a phase is changed, and the closing motion stage of said inlet valve 8 is changed. In addition, a change of the closing motion stage of this inlet valve is made about 180 degrees of maxes as shown in drawing 2 . Moreover, G is a cam action gear which gears with the crank gearing which does not illustrate.

[0010] Drawing 2 and 3 explain an operation of this invention Miller cycle engine of the above-mentioned configuration. First, the exhaust valve 9 of the usual engine opens an inlet valve 10 respectively like this drawing continuous line a, as shown in the dotted line of drawing 2 . It is the diagram a of drawing 3 , it sets like an inhalation-of-air line, and inhales from a point 1, the air of the stroke volume is inhaled in a stroke until an inlet valve closes substantially at a point 2, then, the p-v diagram in the cylinder at that time serves as a compression stroke from a point 2, and the air in a cylinder 2 follows a continuous line a, is compressed, and heightens point a" and a pressure in a top dead center. Moreover, it sets at the time of the low load of the usual gasoline engine. In

order to control a load by inspired air volume of gaseous mixture and to inhale the little gaseous mixture from the point 1 of drawing 3 to d', after extracting inhalation of air by the throttle valve (not shown) and decompressing from a point 1 to point 1' -- inhaling -- point d" -- ' -- compressing -- point d' -- atmospheric pressure -- becoming -- the substantial inhalation at this time -- gaseous mixture -- an amount is expressed with point 1-d'. Point 1-1' at this time - d"' - d' - The area surrounded by 1 serves as negative work, and is reducing the thermal efficiency of a gasoline engine as a pumping loss. being appropriate -- it is alike, and in a Miller cycle engine, the valve timing of an inlet valve 10 is changed according to said closing motion stage adjustment device 25, and an inlet valve 8 is closed in drawing 2 and point d' of 3. At this time, a big over lap occurs between an inlet valve 8 and an exhaust valve 9, since an exhaust valve 9 and an inlet valve 8 are set like an exhaust air line and opened to coincidence, at this rate, exhaust gas is extruded not only the inside of the exhaust air port 7 but in a suction port 6, it sets like the following inhalation-of-air line, and the inhalation of air only of the exhaust gas will be carried out, and an engine serves as operation impossible.

[0011] So, in the Miller cycle engine of this invention, said exhaust gas which is going to flow backwards a check valve 13 in an inlet pipe 14 an induction system and by specifically arranging in an inlet pipe 14 is set like the exhaust air line after it like a stop and the usual engine, and exhaust air is chiefly performed through an exhaust valve 9. As shown in drawing 2 and 3, it is started from a top dead center, an inlet valve 8 closes inhalation of air in point d', and the inhalation of air into a cylinder 2 is ended, it sets like the inhalation-of-air line of the piston 3 after it, and following Line d, as shown in drawing 3 , in a cylinder, gaseous mixture continues adiabatic expansion and is completed like an inhalation-of-air line in bottom dead point d"' like an inhalation-of-air line. Next, it goes into a compression stroke, adiabatic compression of the line d is followed and carried out again, and it becomes the temperature and the pressure of an intake-pressure (for example, setting to non-supercharged engine atmospheric pressure) condition from d"' again in point d'. In this case, the mixed inspired air volume in which the engine carried out inhalation of air is expressed with line 1-d'. And adiabatic compression is carried out more nearly further than point d', and a compression stroke is ended by point d."

[0012] What is necessary is to delay the open stage of an inlet valve 8 with said air inlet cam closing motion stage adjusting device 25, and just to delay valve timing to the location of drawing 2 and the line c of 3 in this invention Miller cycle engine, in order to increase an engine output. this -- inhalation -- gaseous mixture -- by an amount increasing so that it may be expressed to point c', a compression pressure increases so that it may be expressed to point c", and compression temperature also increases according to a compression pressure. drawing 2 and the line b of 3 -- further -- gaseous mixture -- the amount of inhalation is made to increase, the case where an output is increased is shown, Line a shows the full power operational status in the throttle-valve

full open condition of the usual engine, and ENNJIN inhales gaseous mixture to the stroke volume, and it generates the maximum output so that clearly from drawing 2 and 3. A check valve 13 as it is in a location like the continuous line of drawing 1 at this time however, at a certain time Although there is big ventilation resistance and the fault to which an output falls from the usual engine without a check valve 13 occurs when inhalation of air pushes reed valves 21 and 22 open and flows in a cylinder 2 through the through-holes 19a and 20a of ports plates 19 and 20 In this invention Miller cycle engine, since the valve element 16 of the above-mentioned check valve 13 is movable to the dotted-line location of drawing 1 through a shaft 18 with the rotation lever 24 While stopping the function of a check valve 13, said ventilation resistance can be lost and this can raise the full load engine performance to the same extent as the usual engine. In the above-mentioned full load condition, the over lap of the opening area of the inlet valve shown as the opening area and the continuous line a of the exhaust valve shown by the dotted line is the same as the usual engine, and is small, and there is no back flow of the exhaust air to an inspired air flow path, therefore a check valve 13 does not have the need so that clearly [in drawing 2].

[0013]

[Example(s) of Application]

(1) The partial load specific fuel consumption of an Otto cycle engine can be improved, without being able to decrease the amount of the gaseous mixture inhaled in a cylinder, without extracting with the throttle valve of the usual engine, being able to adjust the output to generate continuously, and producing pumping loss in the case of an Otto cycle engine, by setting forward the closing motion stage of an inlet valve to a stepless story one by one with line a->b->c->d, as shown in drawing 2 and 3.

(2) In the compression stroke from the point 2 in drawing 3 , although it is known that 15, then thermal efficiency also with an Otto cycle engine equivalent to a diesel power plant will be acquired in a compression ratio, knocking occurs with a compression ratio excessive in practice, and it becomes operation impossible, for example. However, by changing the closing motion stage of an inlet valve 8 so that it may become the line b of drawing 3 R> 3 by this invention A substantial compression stroke becomes point b" from point b', can carry out to the compression ratio which knocking does not generate, 10 [for example,], and it is possible to reduce a pressure and temperature by this. While preventing generating of knocking, an expansion ratio can be in ** from the compression ratio at the time of the full load of this engine, for example, it can be referred to as 15. By this, there are more workloads than the usual Otto cycle engine, and, moreover, specific fuel consumption may fall to the same extent as the contents shown in the paper (924008) "the high expansion ratio gasoline engine which used the inhalation-of-air control rotary valve" of Society of Automotive Engineers of Japan.

[0014] (3) Although it is generally performed that this makes a compression ratio fall as a cure since the pressure and temperature in a compression stroke top dead center will

rise and knocking will occur, if an Otto cycle engine is supercharged Although the spread of such cures is barred in order that this may cause increase of specific fuel consumption In a compression ratio [in / with this invention Miller cycle engine / the stroke from the point 2 of drawing 3 to point a'''] When knocking is generated by supercharge, by choosing the location of Line b as an inhalation-of-air valve-closing time term, a compression pressure and temperature can be lowered even to b" from a", knocking can be made to avoid, and in addition, in this case, an expansion ratio keeps fixed and does not reduce specific fuel consumption.

(4) This invention can be applied also to invention (patent application by this application people on May 26, Heisei 5) of the Miller cycle engine accompanied by the constant-pressure force of a turbosupercharger, and a constant flow control.

(5) The excessive compression pressure at the time of supercharge of a diesel power plant is also avoidable by applying this invention which can make a compression ratio adjustable.

[0015]

[Effect of the Invention] While this invention Miller cycle engine constitutes said inlet valve of the engine equipped with ** and an exhaust valve so that a phase may be driven to a crankshaft with the air inlet cam shaft which may change Since it is characterized by arranging the check valve which opens a valve element when changing the phase of said air inlet cam shaft to an induction system in a full load condition By having arranged the check valve in having enabled it to change the closing motion stage of the usual inlet valve greatly, and an induction system the conventional Miller cycle engine -- like -- complicated -- weight -- size -- without it uses a rotary bulb -- lightweight -- structure, while an easy Miller cycle engine is realizable When changing the phase of said air inlet cam shaft in a full load condition, by having opened the valve element of a check valve, the inhalation-of-air resistance at the time of a full load is lowered even to a usual engine and this level, and it is effective in offering the Miller cycle engine which can demonstrate a comparable output.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] Important section drawing of longitudinal section of this invention Miller cycle engine

[Drawing 2] ** of this invention Miller cycle engine, the change explanatory view of valve-opening opening area to the crank angle of an exhaust valve

[Drawing 3] The p-v diagram of this invention Miller cycle engine

[Drawing 4] The sectional view of the inhalation-of-air valve timing adjustment device

of this invention Miller cycle engine
[Drawing 5] Drawing 4 is an expanded sectional view a part.
1; Miller cycle engine
2; cylinder
3; piston
4; cylinder head
5; ignition plug
6: Suction port
7; exhaust air port
8; inlet valve
9; exhaust valve
10; air inlet cam shaft
11; rocking lever
12; valve spring
13; check valve
14; inlet pipe
15; valve element
16; valve element
17; ****
18; shaft
19; ports plate
20; ports plate
21; reed valve
22; reed valve
23; guide
24; rotation lever
25; inhalation-of-air valve timing adjustment device
26 26'; bearing
27; helical spline
28; helical spline
29; driving shaft
30; gear tooth
31; gear tooth
32; adjustment piece
33; lever.

[Translation done.]